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HELENA  
URBAN TRANSPORTATION STUDY  
SUMMARY REPORT NUMBER 1

PART I  
TRANSPORTATION PLAN

Prepared by  
MONTANA DEPARTMENT OF HIGHWAYS  
PLANNING AND RESEARCH BUREAU  
in cooperation with  
CITY OF HELENA  
COUNTY OF LEWIS AND CLARK

and  
U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION

June 1, 1974

1970-1990

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## Chapter I

### I N T R O D U C T I O N

The purpose of this report is to document in detail, the methods used in the collection, editing, expansion and analysis of the travel survey data for the Helena Transportation Study Area. The work elements covered in this report were accomplished during the time period from June, 1969, to September, 1972.

Major mileposts in this study to the current time are listed below:  
Spring, 1969 - Montana Department of Highways initiates steps to conduct a transportation study for the Helena Urban Area in cooperation with local authorities.

June and July, 1969 - External travel data survey was conducted.

August to October, 1969 - Home interview survey was taken, together with truck and taxi travel surveys.

November, 1969, to March, 1970 - Coding and manual edits were completed.

February to August, 1970 - Data keypunching and verification was completed.

January to June, 1971 - The machine edits, expansion of sample data, compiling of base year triptables, travel accuracy checks and the base year traffic assignments were completed in this period.

November, 1971 - Trip generation analysis was started.

January and February, 1972 - 1990 study area socio-economic projections finalized.

March and April, 1972-1990 production and attraction figures were cal-





culated. The Gravity Model was calibrated and run.

May and June, 1972 - 1990 Gravity Model triptables were assigned to the Existing Plus Committed Street Network, and to various Proposed Alternate Street Networks.

September, 1972 - The writing of the reports was started.

Spring, 1973 - The printed draft of the Helena Urban Transportation Study, Volume 2, was published.

The general procedures in the processing of the data can be roughly divided into six sections. These sections will be the topics of subsequent chapters.

Chapter II - Origin and destination surveys

Chapter III - Travel Data Edits

Chapter IV - Travel Data Expansion

Chapter V - Population and Employment

Chapter VI - Travel Data Accuracy Checks

Chapter VII - Trip Generation

This report includes numerous diagrams, charts and figures which should be used to supplement the text. The reader will also find a glossary of terms in the appendix. It is hoped this will give a greater understanding of the material contained in the Helena Urban Transportation Study.



Chapter II

METHODS AND PROCEDURES  
USED FOR CONDUCTING  
THE TRAVEL SURVEYS

INTRODUCTION

The comprehensive origin-destination survey made for the Helena Urban Transportation Study area involved three specific types of interviews necessary to establish travel characteristics in the study area for a typical week day. These were (1) the dwelling unit of internal interview (2) the truck-taxi interview and (3) the external interview.

EXTERNAL ORIGIN AND DESTINATION

Interview Stations

Fifteen roads and highways, eight of which are on the Federal Aid Highway Systems, connect Helena to the surrounding areas of the State. Interview stations were located on eight of these roadways at points along the external boundary of the study area. Traffic at these stations amounted to 93.7% of the total traffic on all road crossings of the external cordon line. In relation to the urban area, these eight interview stations were located on Interstate 15 to the north and south, U.S. 12 to the east and west, on old U.S. 91 to the north, and FAS 280 northeast to Lakeside, on FAS 454 to Unionville and on the old packing



plant road east of town. Because of very light traffic on the remaining 7 roads crossing the cordon line, these were eliminated as interview sites. (See Figure II-1)

### Scheduling

Interviewing at the eight stations was distributed over ten working days during the latter part of June and early July, 1969. When working at low volume stations, the interviewing crew was split so that two stations were covered. This was done for both work shifts. Morning shifts were from 6 a.m. to 2 p.m.; afternoon shifts were from 2 p.m. until 10 p.m. or darkness. The schedule was arranged so that a morning and afternoon shift for a given station fell on the same day of the week for two consecutive weeks.

### Procedures and Quality Control

All outbound traffic at each station was interviewed except for short peak hour periods. To avoid excessive delay, "stored" vehicles were intentionally flagged through several stations without interview. In this circumstance, the "stored" vehicles would be flagged through, then interviewing would resume and continue until the number of "stored" vehicles would again become excessive.

The regular interviewing staff for the Helena external study consisted of five interviewers, college students hired for the summer, and one permanent status field supervisor.

Quality control during the interviewing consisted of editing completed interview sheets, informing the interviewer of errors and inconsistencies in his work, and seeking immediate corrective actions as necessary.

There were no extraneous factors, such as bad weather, which affected the external survey.





# 1970 HELENA URBAN TRANSPORTATION STUDY

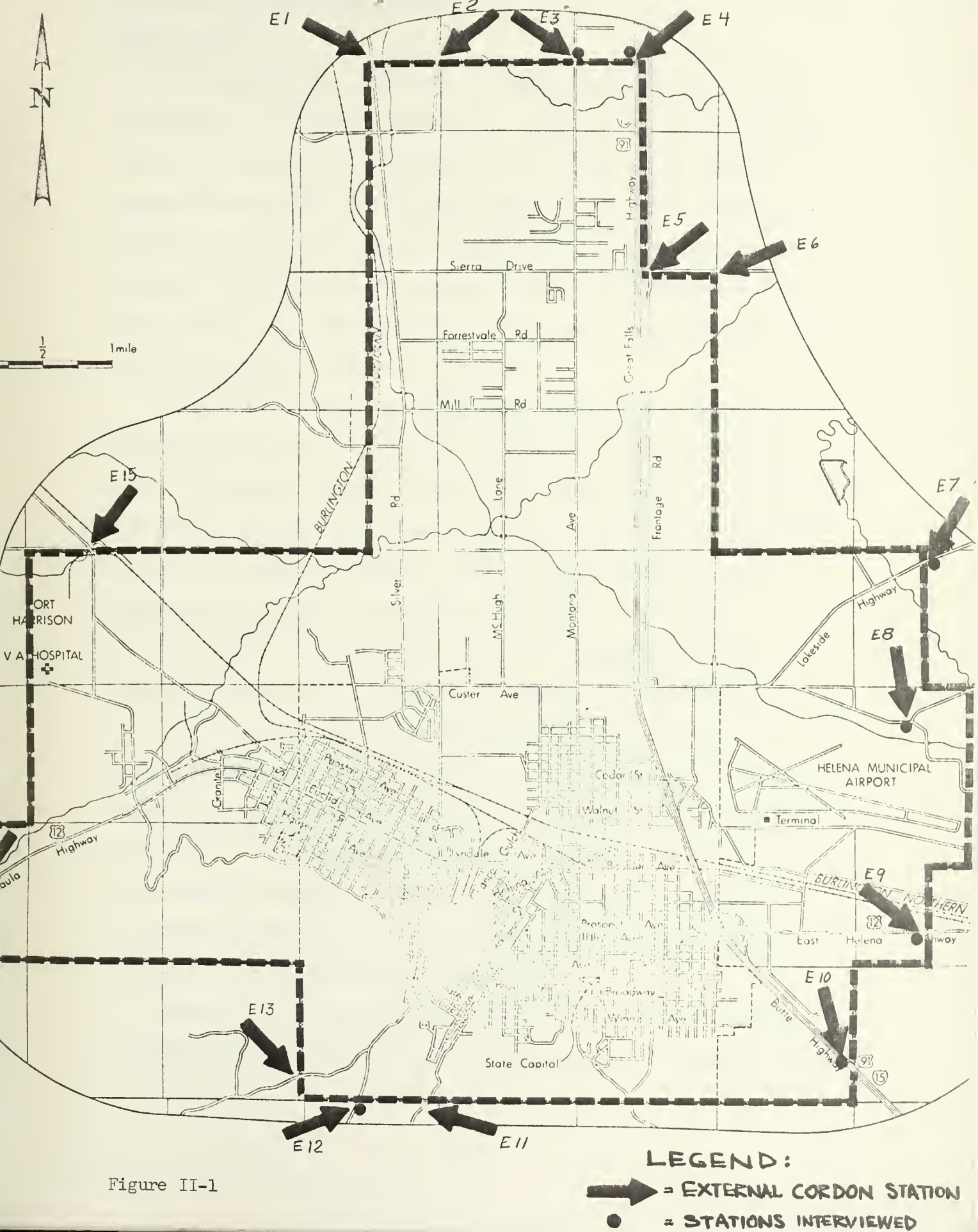


Figure II-1





## THE INTERNAL DWELLING UNIT SURVEY

### Sample Selection

The dwelling unit universe for the internal survey of the urban transportation study was derived from a listing of electrical entrances served by the Montana Power Company. This listing was identified by company supervisors as their "meter route records", with entrances in delimited areas being listed in a serpentine manner, up the alley of one row of city blocks, back along the alley of the next row and so forth. There were approximately 67 of these meter routes located either wholly or partially within the study area.

This particular universe was chosen because: First, nearly all dwelling units in the study area had separate electrical entrances served by the power company. Second, meter records were well maintained and were uniform for most of the study area. Third, listings included the name and address of the most recently billed occupant or owner (generally the occupant for the preceding month). And fourth, listings included information as to the rate charged at each meter, identifying the user as a residential, commercial or industrial customer.

By referring to other company records, it was also possible to identify electrical entrances currently in a disconnected status which proved to be useful in home interviewing operation. Both "metered" and "disconnected" entrances were included in the dwelling universe. A final motive for employment of the residential-electrical entrance universe was the absence of any other reasonably accurate or current listing of housing units for the study area.

Prior to the actual selection of samples for interview, several different checks were made to test the completeness of the power company



records, including comparisons to the most recent city directory and to field listings of random city blocks. The company records proved to be accurate in nearly all instances. The only exceptions noted were in a few of the old, larger apartment houses, government housing projects, and college dormitories where a single meter served the entire complex or building. These exceptions prompted the compilation of a list of apartment houses and other special cases, which was carefully cross-checked with the entrance listings in the sample selection procedure. Single meters serving multiple dwelling units were deleted from the main listings and were placed in separate sub-strata of the universe. These were later field listed and sampled. In addition to a minor number of apartment houses, these special cases included a modern high-rise retirement home (Eagles Penkay Manor), FHA rent assisted apartment complexes (Stewart Homes and Almanor, Inc.) and the dormitories at Carroll College.

In the sample selection procedure, every residential meter on the main electrical entrance listing was identified. The name and address shown for every fifth residence was specifically identified and then transferred to the sample listing sheets. The 20% sample rate is recommended in the FHWA "Manual of Procedures for Home Interview Traffic Study", October, 1954, as updated. As there were numerous meter routes in the study area, 67 in all, careful attention was given to the "carryover" of dwelling units between routes, so that the sampling continued unbroken from one route to the next.

A difficulty encountered in this procedure was that meter route areas were randomly numbered and listed, perhaps in the order that the various sections of the city had originally developed. For instance, meter routes 20, 21 and 22 might have been located in three physically remote parts of the city. The meter route records were active company



records, and only a portion of the listings were available at any one time. In the end, it was generally not possible to continue the sampling between adjoining meter route areas, though this probably would have been the preferred method.

Due to the confidential status of the power company records, a permanent record of the electrical entrance listings could not be reproduced or retained. This required that the sampling efforts be reviewed on a continuous basis, generally at the end of each route. The sample listing sheets, of course, were retained and are available from our files.

A final consideration in using the electrical entrance records was the appearance in the interviewing operation of what initially appeared to be "out-of-route" and duplicate sample addresses. Research into these situations revealed several individuals owning numerous dwelling units other than their own personal residences and having the bills for these units sent to their home addresses. By careful examination of the sample listings, most of these "out-of-route" addresses were readily identified. The preceding and succeeding sample address was then located in the city directory, theoretically ten dwelling units apart, and the dwelling unit midway between would be the missing sample address.

#### Study Publicity

The local newspaper, radio and television stations provided good coverage to the urban transportation study. Some additional, paid commercials used to supplant the news media coverage would have been helpful.

In addition to the public information effort, a letter of notification was also sent to occupants of sample residences. This letter, signed by the Mayor of Helena and the Chairman of the City-County Planning





Board, informed the occupants of the approaching interview and asked then to keep a record of trips made on a specified weekday in a "travelog" which was enclosed. This mailing campaign was carried out by the study staff on a semi-weekly basis in addition to their regular interviewing duties. The timing of the mailings was quite critical as postal sorting and deliveries turned out to be somewhat erratic time-wise. Letters arriving too early would be misplaced or have their travelogues neglected by the recipient. Arriving too late, the letters would be of no use and would be a possible source of embarrassment.

Almost all people who were later interviewed were aware they have received the letter; an estimated 90% read the letter; and 36% had also made some use of the travelog.

#### Interviewer Selection and Training

Seven women telephone interviewers were selected from several sources, including individuals recommended by the local offices of Mountain States Telephone and Telegraph Company, the Montana State Employment Service, and the Personnel Section, Montana Highway Commission. Most of these women had previously been employed or trained in telephone work, such as switchboard operators, interviewers or solicitors. This previous experience was felt to be a definite asset to the urban transportation study. These women carried a major responsibility in completion of most internal area dwelling unit and truck owner-operator interviews.

Two male field interviewers were hired midway in the home interview operation when it became apparent that a number of interviews could not be completed by telephone. The men interviewers were also employed in the field listing work, related to the special supplemental sample, and in the quality control procedure. Both men were selected from lists





initially screened by the Personnel Section, Montana Highway Commission. Training consisted of several hours of formal instruction, immediately followed with practice interviewing. The women responded very well to actual interviewing followed by short sessions in which various experiences were shared and discussed. These sessions were held several times a day for the first several weeks and were later cut back as proficiency and understanding increased. Actual telephone interviewing began on the second or third day of training depending on the individual.

#### Interviewing Quality Control

Quality control procedures were extensive including interview monitoring, comparison and examination of completed interviews, and random reinterviewing of both whole interviews and selected items (telephone and in-person).

1. Surveillance of quality was afforded to the study supervisor through an electronic listening device wired into all of the survey office telephones. This listening apparatus, whose existence was well known to the interview staff, made it possible to monitor interviews in progress without the interviewer or interviewee being aware of the third party listening. At least two interviews per week for each interviewer were completely monitored by the supervisor or an assistant on an unannounced basis. The interview was manually recorded and compared to the actual interview so as to facilitate counseling of the interviewer if needed.
2. Each sample was assigned to a specific interviewer to be completed on a specified date. Samples were assigned equally by a random procedure to insure over a period of a week or more, an



equality of data returns. Simple tabulations of these data returns were then made to compare the output of various interviewers. Those interviewers with noticeable variances from the norm were more closely observed and instructed as necessary.

3. Several times a day in the normal course of work, interviewers would finish and hand in interviews. These interviews would soon afterwards - preferably the same day - be closely examined by the study supervisor or an assistant. If errors, omissions or inconsistencies were found, the interview was returned to the original interviewer. She then had to recontact the sample occupants in an effort to correct or complete the interview. If the recontact was unsuccessful due to the lack of cooperation for one of several possible reasons, the supervisor telephoned the dwelling unit or referred the interview to a field interviewer. It was found that people generally responded much more readily in person-to-person situation than over the telephone.

## TRUCK SURVEY

### Sample Selection

For sampling purposes, the State of Montana truck registration file for Lewis and Clark county was selected as the most current and perhaps the only reliable source of a truck universe for the Helena Urban Transportation Study. As it was necessary to go through each registration to choose only those that were within the study area, the task was time consuming.

Truck registration cards for 1970 were first sorted by gross vehicle weight into four subgroups as follows: 6,000 lbs.; 8,000 to 14,000 lbs.; 16,000 to 24,000 lbs.; 26,000 lbs. and over. This sampling stratification



has been found necessary in several other studies in Montana to insure a data return for the larger truck units. Trucks in the first group, pickups, were sampled with the dwelling unit survey, and excluded from further processing. Trucks in the other three groups were sorted separately by license plate numbers. Every fifth truck in each of these groups was then selected for interview from a random start. Sample lists were then started with license and receipt numbers, and completed by adding the name and address of the registered owner from the truck ownership list.

The final study area truck sample was composed of 790 of the 1,300 larger trucks (8,000 G.V.W. and over) registered in Lewis and Clark County. One hundred fifty six (156) truck samples were selected from the state registration lists, and eight (8) additional truck samples were selected from lists supplied by Federal Government agencies. One thousand three hundred thirty five (1,335) truck trips were incorporated in the 1969 O-D total triptables.

## TAXI SURVEY

### Methods and Procedures

Data on taxi trips was obtained from the one taxi company by an interviewer personally calling on the company manager. The desired data was on the company central dispatch records and on the vehicle fee sheets. With the permission of the manager, these records were reproduced for a recent, randomly selected travel date and the original copies were then returned to the company. Since all trips made by all vehicles are included on the coding sheets for the selected travel date, the samples were later expanded by a factor of 1.00. Five hundred seventy five (575) taxi trips were incorporated in the 1969 O-D total triptables.



### Chapter III

## D A T A   C O D I N G   A N D   E D I T I N G

### CODING

During the first half of 1970, the Urban Planning Staff completed interviewing coding for the Helena Urban Transportation Study. Interviews committed to coding included the Dwelling Unit Summary Sheets (#1 Cards), the Dwelling Unit Internal O-D Trip Records (#2 Cards), the External Cordon O-D Trip Reports (#3 Cards), the Internal Truck Trip Reports (#4 Cards) and the Internal Taxi Trip Reports (#5 Cards). The use of abbreviated staff coding manuals insured uniformity of coding efforts among the coders involved. Data elicited during the interviews and later coded was based on data requirements listed in the FHWA "Manual of Procedures for Home Interview Traffic Study, Oct. 1954, as updated.

### EDITING

Both manual and machine edits were made upon the various interview data used in this study. Manual editing was performed by the study supervisor on a continuing basis throughout the entire coding period. The coding on an estimated one-third of all interviews was intensively reviewed for thoroughness and accuracy and selected items, such as zone of residence, and zone of trip origin and destination, were checked on all interviews either by the supervisor or another coder. Any coding errors at this point were corrected on the interview-code sheets, and the data was then forwarded







for keypunching and keypunch verification. The study supervisor took note of repetitious errors, brought this to the attention of the individual coder, and sought corrective actions when necessary. Upon conclusion of the keypunching and verification, the data cards were input into several staff developed programs to check the validity and completeness of the coded data.

The IBM 360 programs, while performing the major checks included in the older FHWA "E-X" programs for IBM 1401, contained several checks for unlikely or impossible codes in specified coding fields, ranges of correct codes, blank data fields, cross-contingency checks (to assure if one field had a certain code, another field would have some other related or specified code), and checks for duplicate coding. A program was also developed to crosscheck related items on both #1 and #2 Cards. If a probable coding or keypunch error was identified by one of the programs, a message giving the interview number, the suspect field, and the type of error was printed as program output. The original interview code sheet was then inspected and corrected as necessary, and a revised data card keypunched. The corrected cards were then "collated", or sorted into the original keypunch card deck, with the cards in error being removed from the deck. Although automatic machine collation was available, it was found that this procedure was not successful, and manual collation was generally used instead. Experience indicated that extensive hand sorting was invariably necessary after an automatic collation, sometimes with a greater expenditure of time than had a manual procedure been used in the first place.

In the initial manual edit, an estimated 10% of all internal and external interviews were corrected before keypunching, and about 15% of the data cards were revised after the computer edits were made.



## Chapter IV

### D A T A     E X P A N S I O N

#### INTRODUCTION

Most travel and other related data for an urban transportation study is collected on a sample basis. This eventually requires a multiplication (or expansion) of the sample to represent a known universe of dwelling units or vehicle trips. Each of the five types of data cards has a separate, standardized expansion procedure. Except as noted, the expansion of the samples for the Helena Urban Transportation Study followed the procedures and formulas recommended in the FHWA "Manual of Procedures for Home Interview Traffic Study" October, 1954, as updated.

#### "EXTERNAL" SAMPLE EXPANSION

In the Helena study, drivers of vehicles outbound from the study area were interviewed, in contrast to the more common practice of interviewing both inbound and outbound traffic. The interviews were then coded, edited and expanded on an hourly basis for cars and trucks as in the recommended procedure. This included an overall factoring for drivers not interviewed, because of the night hours or being flagged through during peak hours, and an adjustment of trips to an average of five weekdays. The exception to the usual expansion procedure was that the outbound trip records were factored to represent the volumes of both outbound and inbound traffic by hour.



The major reason that only outbound roadside interviews were made was that experience with "external" surveys in other Montana cities indicated that many inbound motorists in summer months were (and are) tourists unfamiliar with the study area. These tourists usually do not know if they will stop, or if they do plan to stop, where that stop would be. Of the traffic entering and leaving the Helena study area during the summer interviews that was counted and classified, one-fourth to one-third of all vehicles were from states other than Montana. The drivers interviewed outbound from Helena were able, almost without exception, to give an accurate recollection of an establishment name or address of their last stop, or, in the case of through trip, sufficient information to determine the highway upon which they entered the area.

After final corrections were made following the computer edits, expansion factors were calculated by station, hour and vehicle type and then added to the No. 3 External Trip Cards. The formula for calculating the expansion factors followed the guidelines in the "Manual of Procedures for Home Interview Traffic Study" is as follows:

$$\text{Hourly Factor } F = \frac{S}{T} \times \left( \frac{V}{W} \times \frac{O}{P} \right)$$

where:

S = 24 hour average weekday traffic for five days for all vehicles.

T = 16 hour average count of all vehicles for five days.

V = Average automatic count for five days of all vehicles during the applicable hour.

W = Number of all vehicles counted during the applicable hour on the day of interview.

O = Actual number of vehicles (By vehicle type) counted during the hour of interview.



P = Number of Completed interviews obtained for each vehicle type during the hour of interview.

In later processing, an inbound trip record was simulated (in card format) by reversing the trip origin and destination of each outbound trip record and introducing one-half of the original expansion factor onto both the inbound and outbound record. These "half-factor" cards then represented traffic both inbound and outbound from the study area.

Based on the coding of the external records, these trips were then subdivided into three major categories: 1. those trips with a termination point, either an origin or destination, inside the study area; 2. those passing "through" the study area without stopping; 3. those passing "through" the study area, but with an intermediate stop for some people, such as to eat, shop, or fill with gas.

The first of these groups, identified on the computer listings as "E-I (External-Internal) One-half Factor Trips" were segregated from the "E-E (External-External) Trips" and required no further treatment before inclusion in the External O-D triptables. Because any given trip in the second or third category would have been theoretically counted and expanded at two external stations, this required the E-E records be again half-factored resulting in "quarter-factor" trip records. The two types of through trip records were then separated into those without intermediate stops. A final procedure for the latter group was to split each record into new "E-I" and "I-E" cards, with the traffic zone of the intermediate stop being transferred to the internal ("I") traffic zone position on each record. This latter group was identified as "1/4 Factor E-I Trips".

The expansion factor calculations at the External Station on Interstate 15 south of the Capitol Interchange is shown in Table IV-1. These same expansion calculations were carried on at all the external stations.







TABLE IV-1  
EXPANSION FACTOR CALCULATIONS  
EXTERNAL STATION NO. E-10  
ON INTERSTATE 15 SOUTH OF HELENA

DATE	HOUR	TOTAL VEHICLES ON HIGHWAY				PASSENGER CARS				TRUCKS				16 HOUR FACTORS				24 HOUR FACTORS				FINAL FACTOR X NUMBER INTERVIEWED	
		Five Day Count (Avg.)	Counted Day of Interview	W	V/W	Counted Day of Interview	Number Inter- viewed	Car Factor	O/P	Counted Day of Interview	Number Inter- viewed	Truck Factor	O/P	Cars	Trucks	R	Trucks	Cars	Trucks	F	F	Cars	Trucks
6/30/69	6-7	76	73		1.041	65	55	1.182	1.182	8	5	1.600		1.230	1.666			1.367	1.851			75	9
	7-8	131	176		1.028	166	75	2.213	2.213	10	9	1.111		2.275	1.142			2.528	1.269			190	11
	8-9	124	117		1.060	103	64	1.609	1.609	14	7	2.000		1.706	2.120			1.895	2.355			121	16
	9-10	128	84		1.524	75	51	1.471	1.471	9	8	1.125		2.242	1.715			2.411	1.905			127	15
	10-11	164	133		1.233	118	33	3.576	3.576	15	3	1.000		4.409	6.165			4.848	6.849			162	21
	11-12	159	157		1.013	132	67	1.970	1.970	26	11	2.273		1.996	2.303			2.218	2.559			149	28
	12-1	153	119		1.286	106	68	1.559	1.559	13	11	1.182		2.005	1.520			2.228	1.689			152	19
	1-2	185	135		1.370	109	57	1.912	1.912	26	5	2.889		2.619	3.958			2.910	4.397			166	40
	2-3	181	170		1.065	140	79	1.772	1.772	30	13	2.308		1.887	2.458			2.096	2.731			166	36
	3-4	185	172		1.076	146	82	1.780	1.780	26	15	1.733		1.915	1.865			2.129	2.972			174	31
	4-5	231	230		1.004	207	109	1.899	1.899	23	7	3.286		1.907	3.299			2.119	3.665			231	26
7/11/69	5-6	234	251		0.932	233	141	1.652	1.652	18	5	3.600		1.540	3.355			1.711	3.727			241	19
	6-7	142	163		0.871	148	84	1.762	1.762	15	5	3.000		1.535	2.613			1.705	2.905			143	15
	7-8	134	188		0.713	179	80	2.238	2.238	9	4	2.250		1.596	1.604			1.773	1.782			142	7
	8-9	124	143		0.867	138	73	1.390	1.390	5	2	2.500		1.639	2.168			1.821	2.409			133	5
	9-10	99	115		0.861	109	63	1.730	1.730	6	4	1.500		1.490	1.292			1.655	1.435			104	6
																						2476	304

Expansion, 16 to 24 hours =  $S/T = 2778/2500 = 1.111$

2476  
+ 304  
2780



## HOME INTERVIEW SAMPLE EXPANSION

Home interview data recorded in the fall of 1969, including the internal car and pickup trips, was expanded to represent a universe of dwelling units within the study area. The expansion of the trip data was additionally checked in a "Screenline Crossing Comparison Procedure", a recommended analysis covered in Chapter VI, "Travel Data Accuracy Checks".

Information to establish the dwelling unit universe was derived from two main sources: 1. For the incorporated area of the City of Helena, the dwelling unit totals by Enumeration District from the 1970 U.S. Census were used. 2. For the area outside the city limits, a field inventory of dwelling units in the fall of 1969 was used. This inventory was originally completed as a check on the number and distribution of samples in the outlying residential districts drawn from the power company meter listings. This check indicated that electrical meters outside the city limits had not been sequentially listed in the areas of newer construction, leading to some variability in the sample (or expansion) rates among traffic zones in that area.

In the dwelling unit sample selection described in Chapter 2, every fifth dwelling unit on the meter listings was designated as an address for inclusion in the sample. Although the application of a gross factor of 5.0 to the entire sample would have been one possible method of expansion, this is not a recommended nor acceptable procedure. An expansion to known totals for districts or sub-areas of an urban area, such as Census Enumeration Districts, is generally preferred.

For the expansion within the Helena City limits, the initial step was a comparison of boundaries of traffic zones and Census Enumeration Districts (E.D.'s). By overlaying maps of the same scale showing the two types of areas, it was then possible to divide the area in the city of



Helena into eight (8) "superzones" where groups of zones had common or reasonably close boundaries with E.D.'s or groups of E.D.'s. In the event of close boundaries, listings of dwelling units in the affected areas were made, tabulated, and the totals for the E.D.'s adjusted accordingly. The number of dwelling unit samples in each superzone was then divided into the adjusted Census total for the same area to yield the final expansion factors.

For the area outside the city limits, the number of samples in each traffic zone was divided into the tabulated total dwelling units for each zone to give the final expansion factors.

"Missed" and "non-dwelling unit" samples were considered to be insignificant (2.0% of all samples), as they amounted to only two percent of the total and were a very uniformly dispersed throughout the study area. Consequently, they were not included in the computation and application of the final expansion factors. The "missed" samples, 34 in all, included dwelling units where the occupants refused to cooperate or were not home after repeated calls and where sufficient information could not be definitely established to complete the interviews. The "non-dwelling" samples, 8 in all, were largely residential style buildings that had been converted to commercial or professional use. "Vacant" dwelling units in both the sample and related Census totals were included in the computation of expansion factors.

Data for the superzones in the city limits, the equivalent E.D. totals, data for the zones outside the city limits, and the final expansion factors are shown in Table IV-2. Equivalent data for the traffic zones outside the city limits is shown in Table IV-3.



TABLE IV - 2

## DWELLING UNIT EXPANSION FACTORS AND RELATED DATA

<sup>1</sup> District No.	Census Enumeration District	Census Housing Units <sup>2</sup>	Adjusted Housing Units	Traffic Zone Numbers	No. Valid Samples <sup>3</sup>	Final Expansion Factors
1	17A, 17B, 18	873	883	32, 37-45	185	4.77
2	19 - 21	583	573	33 - 36	120	4.78
3	22 - 24, 28	1350	1403	1-11, 49-54	278	5.05
4	25-27, 29, 30	1331	1278	12-30, 55-59	262	4.88
5	12 - 14	609	609	46, 47, 84-90	120	5.08
6	15, 16	668	652	48, 77-81, 83	135	4.83
7	32	411	411	72, 73, 82	84	4.89
<u>8</u>	<u>31, 33 - 38</u>	<u>2223</u>	<u>2239</u>	<u>60-71, 74-76</u>	<u>449</u>	<u>4.99</u>
Subtotal City Limits (excluding group quarters)		8048	8048		1633	(4.93) <sup>5</sup>
Subtotal Units in group quarters <sup>4, 6</sup>			671		133	5.05
Total, City Limits			8719		1766	(4.93) <sup>5</sup>
Subtotal, Outlying Area			1181		254	(4.67) <sup>5</sup>
Total, Study Area			9900		2020	(4.89) <sup>5</sup>

<sup>1</sup>Not comparable to the trip generation analysis districts.

<sup>2</sup>Census housing tabulations for the city limits do not have any provision for units in "group quarters".

<sup>3</sup>Includes only "occupied" and "vacant" samples and excludes "missed" samples as discussed in text.

<sup>4</sup>From field inventory this study, no Census totals available for the comparable area.

<sup>5</sup>Area wide factors that were not actually applied to interview data.

<sup>6</sup>For both sampling and expansion purposes, each group quarters occupant was considered to be residing in a separate dwelling. The only group quarters identified in the Transportation Study were the dormitories at Carroll College.







TABLE IV - 3

## DWELLING UNIT EXPANSION FACTORS AND RELATED DATA

## FOR STUDY AREA OUTSIDE THE CITY LIMITS

<u>Zone No.</u>	<u>Total* Dwelling Units</u>	<u>No. Valid Samples</u>	<u>Final Expansion Factors Applied To Interviews</u>
91	15	4	3.75
92	34	7	4.86
93	--	--	--
94	35	7	5.00
95	--	--	--
96	70	14	5.00
97	110	21	5.24
98	1	--	--
99	83	16	5.19
100	59	12	4.92
101	73	17	4.29
102	44	9	4.89
103	19	6	3.17
104	78	17	4.59
105	45	12	3.75
106	20	4	5.00
107	48	11	4.36
108	2	--	--
109	27	8	3.38
110	5	1	5.00
111	23	5	4.60
112	52	10	5.20
113	103	22	4.48
114	46	13	3.54
115	40	8	5.00
116	49	10	4.90
117	34	7	4.86
118	29	6	4.83
119	<u>37</u>	<u>7</u>	5.28
Total	1181	254	(4.67)

\*From field inventory records.



## TRUCK AND TAXI SAMPLE EXPANSION

Truck and truck trip expansion was accomplished by multiplying the number of samples by the reciprocal of the sample rate, a factor of 5.0. This simplified procedure was necessitated by the fact that a reliable, independent listing of trucks garaged in the study area (suitable as a universe for expansion) did not and does not exist. As the truck registrations were current within several months of the sampling, it was felt that very few additional trucks would have been garaged in the study in the intervening period. Also, the size of the truck universe was very small and the contribution of truck trips to the Total Purpose 1969 O-D Trip Table was very minimal (1,339 trips out of 111,390 - or 1.2%). "Missed" truck interviews were negligible.

It should be recalled that only trucks 8,000 lbs. and over were sampled, and that pickups (either owned or used) and pickup trips were included within the home interviews.

Taxis were sampled on a one hundred percent basis for one random day of trips, resulting in a factor of 1.0 being applied to the taxi data. Like the trucks the 575 taxi trips were a very minor factor in base year triptables.



Chapter V

D W E L L I N G     U N I T S

P O P U L A T I O N     A N D     E M P L O Y M E N T

The purpose of this chapter is to examine the quality of the expanded 1969 home interview and other data as collected and/or developed for use in the Helena Urban Transportation Study. Comparisons to independent data sources, primarily the U.S. Census, are included.

DWELLING UNITS

Residential living quarters, technically referred to as "dwelling units" or "housing units", are a basic element of the urban area, and are one of the most important factors related to urban travel and trip making. In the Helena study, fifty-five percent (55,045 out of 99,356) of all internal area trips had either an origin or a destination at "home", plus there was undetermined percentage of the external-internal trips. In addition, the distribution of dwellings is important because of a direct relationship to the distribution of area population.

Although later in the study, dwelling units were expanded to match Census totals, the transportation study dwelling samples were initially selected from a universe of residential electrical entrances by a carefully supervised sampling procedure. Further these samples were selected at the relatively high sample rate of twenty percent. This suggests the application of a constant 5.0 expansion factor would yield one valid



representation of the dwelling universe. Other tabulations of this universe included a summary of the city directory listings and other local records tabulated for 1968 by the staff of the Helena City-County Planning Board, and finally, the published totals of the U.S. Census Bureau. District totals for these three data sources are compared in the following table:

Table V-1

NUMBERS OF DWELLING UNITS BY EXPANSION

DISTRICTS FOR THE CITY OF HELENA

Expansion District <sup>1</sup>	1969 Helena Urban Trans. Study <sup>2</sup>	Percent Variance from 1970 Census	1968 Helena City-County Plan Board	Percent Variance from 1970 Census	1970 U.S. Census
1	920	+4.2	990	+12.1	883
2	600	+4.7	532	- 7.2	573
3	1400	-0.2	1292	- 7.9	1403
4	1310	+2.5	1279	0.0	1278
5	594	-2.5	618	+ 1.5	609
6	675	+3.5	644	- 1.2	652
7	420	+2.2	413	+ 0.5	411
<u>8</u>	<u>2245</u>	<u>+0.3</u>	<u>2100</u>	<u>- 6.2</u>	<u>2239</u>
TOTAL	8164	+1.4	7868	- 2.1	8048

<sup>1</sup>See Table IV-2.

<sup>2</sup>Sample Expansion by a constant factor of 5.0.





Although this preliminary expansion of urban transportation dwelling data was not used in the study procedure, the fact it varied from the Census total by only 1.4 percent tends to establish the accuracy of the sampling procedure. Variance of the study data by districts inside the city limits was within a relatively close range of percentage points, indicating the internal stability of the sample. As might be expected, the smaller districts show the largest percentage variance from the Census norms. The tabulation supplied by the City-County Planning Board indicates a much wider range of variability compared to the Census data.

#### POPULATION

The expanded data summary from the home interview study (Appendix A) shows 23,865 people residing in the City of Helena in 1969. An additional 4021 persons were reported as residing in the remainder of the study area. This resulted in a total of 27,886. The U.S. Census listed 22,730 people for the city proper in 1970, which was 1135 persons less than the figure from the home interviews, or a difference of about five percent. This variance was thought to have been due in part to the inclusion of all resident, fall term students at Carroll College in the home interview survey as in the Census enumeration, in addition to other college students normally enrolled at universities in other localities, who were living in Helena for the summer. Approximately fifty percent of the home interviewing was completed in August, 1969, before the start of the fall college term. This latter group of students was not included in the Census totals for the Census was taken in April and May, 1970, while these same students were away attending school.

The variance in total population was examined in more detail through



the expansion districts (see Table IV-2) for consistency throughout the city. The results of this comparison was shown in Table V-2. This table indicates that District 6, the Stewart Homes--Northern Pacific Depot area--had only eighty-five percent of the Census population reported. This was in contrast to the opposite pattern for the rest of the city, where transportation data indicated a seven percent surplus over the Census total. A more detailed analysis, involving a tabulation of Census block statistics, indicated sampling error in several traffic zones. As the Census Block statistics were not available at the time the expansion factors were calculated, no adjustment was made to effect a more correct expansion.

Another partial explanation for this variance in District 6 was the considerable number of dwelling units in Zone 77 being vacant in the newly completed Eagles Manor and low-cost Almanor, Inc., at the time the home interviews were being taken. These dwellings would have been largely occupied when the Census was taken seven to eight months later.

Population Data for District 4, the urban renewal area, was in exact agreement with the Census total. This also contrasted to the city wide comparison. The area had a very high percentage of elderly and retired persons, perhaps upwards of 3/4 of the population, with an absence of youngsters and college age adults.



TABLE V-2

## HELENA URBAN TRANSPORTATION STUDY

## Comparison of Population Data, 1970

## City of Helena

District	Census Enumeration District	Population/ Census Enumeration Districts	Adjusted Population/ Enumeration Districts <sup>2</sup>	Transportation Zone Numbers	Population After Expansion	Ratio UTS Pop./ Census Pop.
1	17A, 17B, 18	2793	2839	32, 37 - 45	3091	1.09
2	19, 20, 21	1948	1902	33 - 36	2136	1.12
3	22 - 24, 28	2889	3033	1-11, 31, 49-54	3253	1.07
4	25-27, 29, 30	2908	2764	12 - 30, 55 -59	2764	1.00
5	12, 13, 14 <sup>1</sup>	1945	1945	46, 47, 84 - 90	2076	1.07
6	15, 16	1951	1934	48, 77 - 81, 83	1651	0.85
7	32	1009	1009	72, 73, 82	1118	1.11
8	31, 33 - 38	6681	6698	60 - 71, 74 - 76	7105	1.06
Subtotal		22,124	22,124		23,199	
+ Carroll College		606			671	
Total		22,730			23,865	1.05

<sup>1</sup>Excludes resident population in dormitories at Carroll College (606 persons).

<sup>2</sup>Population for this column was based upon dwelling unit adjustments described in Chapter IV. A persons per housing unit ratio was calculated from Census E.D. data and then applied to the dwelling unit adjustments.



## NUMBERS EMPLOYED BY PLACE OF RESIDENCE

The expanded data summary from the home interview survey (Appendix C ) shows 9139 employed persons residing inside the Helena city limits, but not necessarily all working in Helena, and 1531 in the study area outside the city for a total of 10,670. Included in these tabulations were employed persons 19 years and over, and persons 16 to 18 years old who indicated they were not enrolled in high school and were employed on a regular part-time or full-time basis.

The 1970 U.S. Census shows 9842 employed persons<sup>1</sup> residing in the Helena city limits, with an estimated 1700 employed persons<sup>2</sup> residing in the balance of the study area, which totals to 11,542. Included in these figures were all employed persons 16 years and older, irregardless of whether or not those in the high school age group were also enrolled as students, or of the status or length of employment of these 16 to 18 year olds. Research through the Census reports revealed data for the city which was used to adjust the Census total employed to compare to the data from the urban transportation study as follows:

Number employed persons, 16 years and over	= 9842
Less number employed persons, 16 through 18 years	= 805 <sup>3</sup>
Plus estimated number employed, 16 through 18 years not enrolled in high school	<u>604</u>
Number of employed persons 19 years and over, and employed non-students 16 through 18	9097

<sup>1</sup>U.S. Census, "General Social and Economic Characteristics, Montana, 1970", Table 105, pg. 183 (occupation totals).

<sup>2</sup>Estimate derived from percentage of employed persons and total population in the City of Helena ( $9842/22730 = 43\%$ ), applied to population in the balance of study area ( $4021 \times 43\% = 1729$ ).





This adjusted Census figure compares closely to the 9139 employed persons from the transportation study, a variance of only 42, or about 1/2 of one percent. This agreement was not unexpected since the two data sources were not completely independent of each other (i.e., the transportation dwelling sample was expanded on the basis of Census dwelling unit totals). This comparison was valuable as it helped to verify the accuracy of the home interviews. It would have been possible, for instance, to have had very close or exact agreement in the dwelling unit totals and still have had considerable divergence in the numbers employed. However, the good comparison in this category of data indicates the overall validity of the dwelling unit sampling.

A similar comparison for the study area outside the city limits was not possible because the necessary Census data was not available for that area.

<sup>3</sup>Op. Cit. "Social and Economic Characteristics", Table 104, pg. 182, (percent in labor force by ages); U.S. Census "General Population Characteristics, Montana 1970", Table 28 pg. 54 (numbers in age groups).

<sup>4</sup>Ibid. "Social and Economic Characteristics", Table 103, pg. 181, (number enrolled in high school - four year basis - residing in the City of Helena = 1749).

Ibid. Population Characteristics, Table 28, Pg. 54 (number 15 to 18 year olds, City of Helena = 1909).

This indicates 160 individuals 15 to 18 years not enrolled in high school. Sixty of these non-students were assumed to be employed, or about forty percent of the group.



Chapter VI

T R A V E L     D A T A

A C C U R A C Y     C H E C K S

HELENA SCREENLINE COMPARISONS

In order to check the accuracy of the expanded O-D trip from the home interview and adjust the expansion of the trip data, two traffic screenlines were chosen (see Figure IV-1). These imaginary screenlines were physically located as to intersect major traffic movements within the study area, not to divide traffic zones and to keep multiple trip crossings at each screenline to a minimum. Screenline "A", running predominantly along Columbia and Davis Streets, divided the study area into eastern and western parts. Screenline "B", the north-south division line, was located along the Burlington Northern main line tracks.

Vehicles crossing the screenlines were counted mechanically for a full week. Streets with major traffic volumes were manually counted and classified over a sixteen hour period. The manual counts were then summarized and plotted by hour and vehicle type (car or truck) together with comparable categories of the O-D trips crossing the same screenlines. This comparison revealed that for the twenty-four hour total only 66 percent of the actual car and 60 percent of the actual truck crossings were accounted for by the crossings obtained from the expanded O-D trip data.

Several alternate screenline factors were then applied to the expanded



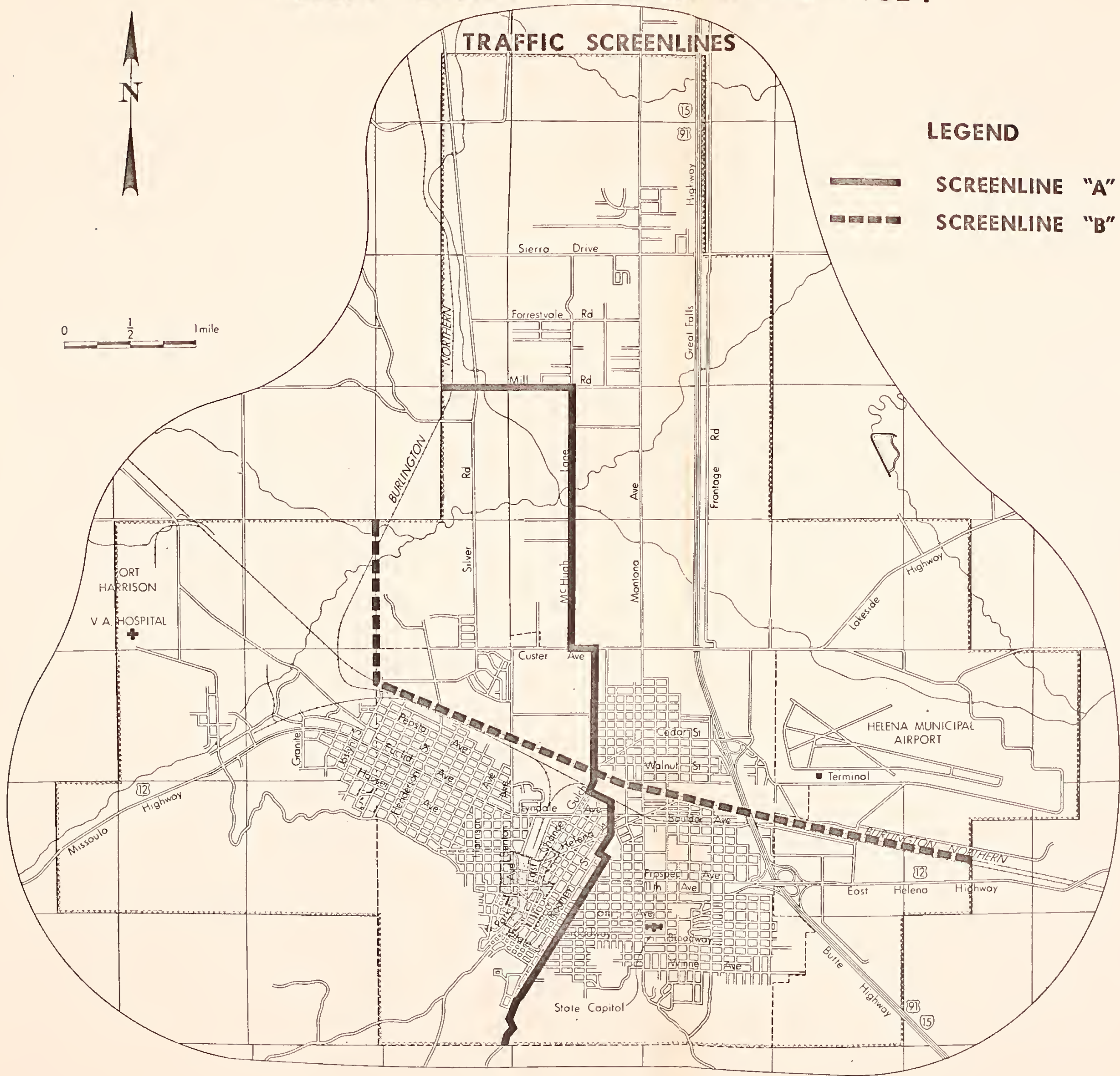
trip data on a trial basis. The results of these trials were then plotted and compared to the initial plots to find the best combination of overall visual fit while keeping the twenty-four hour adjusted O-D trip totals as close as possible to the total ground counts. The best fit occurred in the peak traffic periods of 7-9 a.m. and 4-6p.m. when most trips were of the home-to-work or work-to-home variety. Since the number of external trips ending inside or passing through the study area were fully known (due to the intensive counting and interviewing program), the observed shortage of expanded O-D trips in the off-peak hours indicated the necessity of a further factoring of the internal trip data.

Since the screenline comparisons indicated the home survey interviewees reported most of their work trips, the differences between the actual and reported crossing of the screenline in off-peak hours were attributed to an underreporting of the non-work trips. This left only the HBO and the NHB to be factored. Therefore, the adjustment of the expanded trip data to the actual crossings was achieved by multiplying the non-work trip categories by a factor of 1.8 for cars and 1.7 for trucks. In keeping with recognized procedures, this adjustment was made for the total twenty-four O-D trip table rather than on an hourly basis. The factored origin and destination trips crossing screenline "A" then accounted for 98 percent of the actual car trips and 101 percent of the actual truck trips crossing the same screenline. (See Figures VI-2 through VI-5).





# HELENA URBAN TRANSPORTATION STUDY







# SCREENLINE COMPARISONS — CARS

SCREENLINE "A"

## LEGEND

- GROUND COUNT
- HBO & NHB O-D TRIPS ADJUSTED
- - - HBO & NHB O-D TRIPS
- - - HBW O-D TRIPS
- ..... EXTERNAL O-D TRIPS

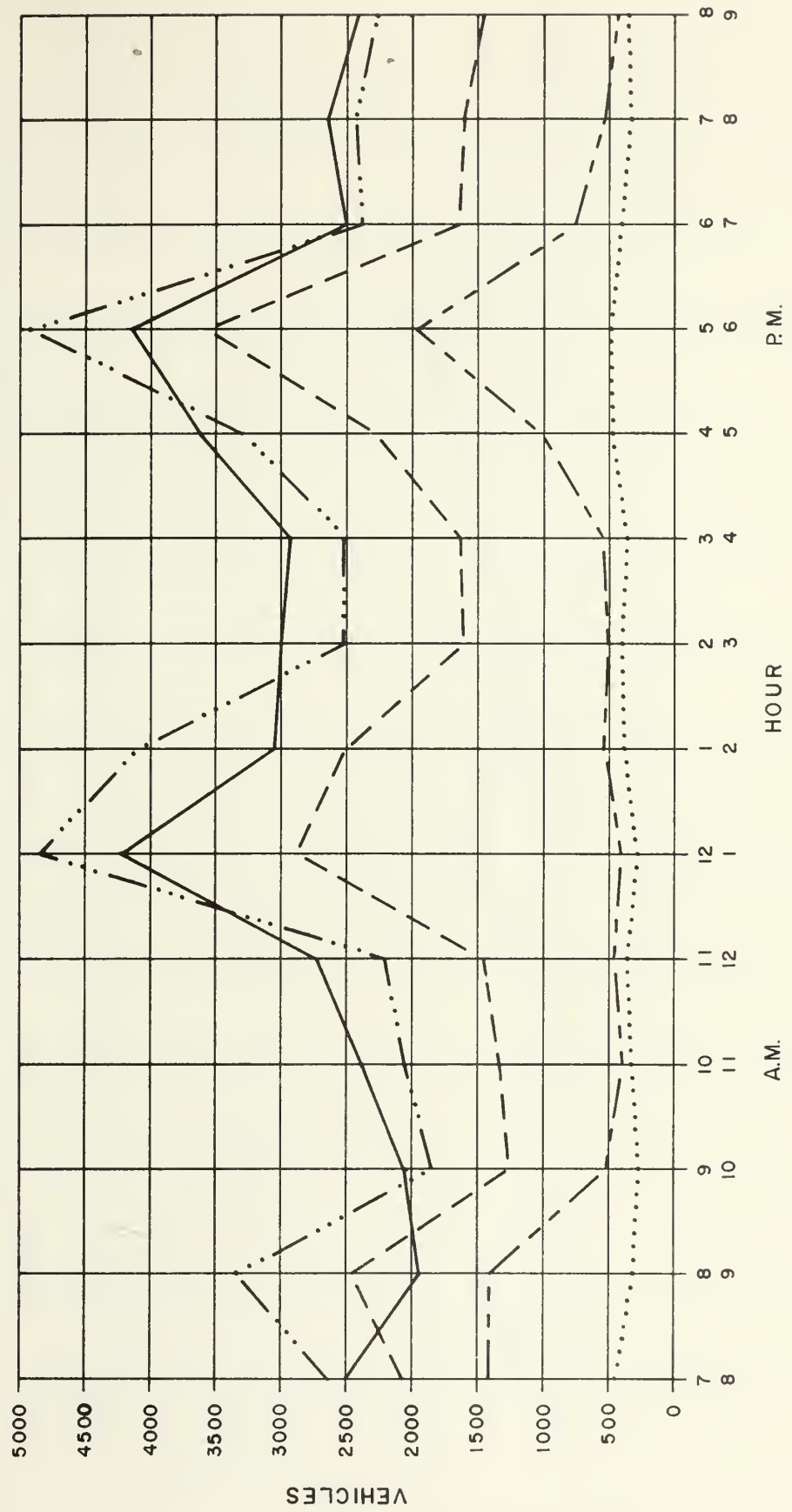


FIG. VI-2

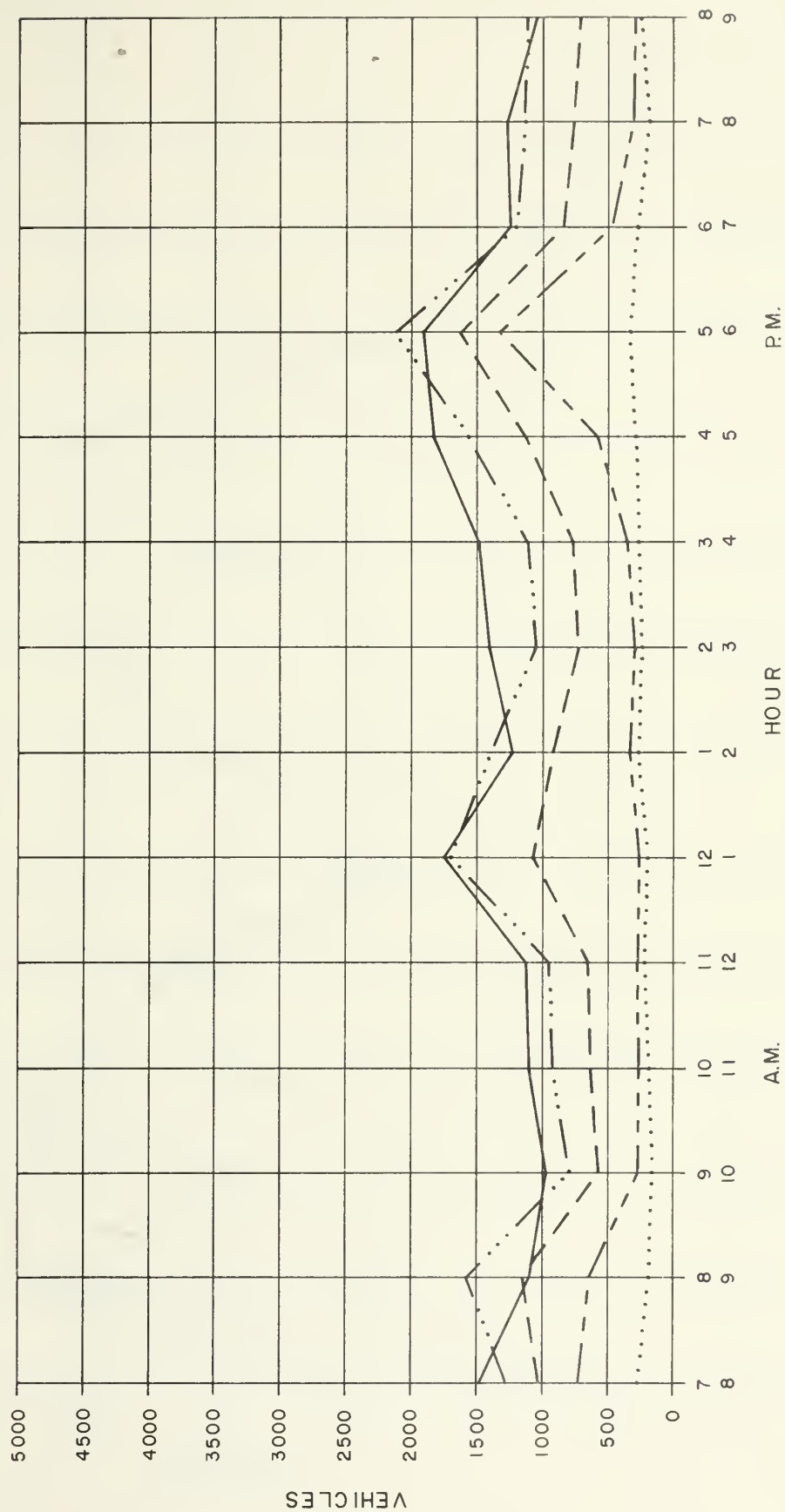


# SCREENLINE COMPARISONS — CARS

SCREENLINE "B"

## LEGEND

- GROUND COUNT
- - - HBO & NHB O-D TRIPS
- - - HBO & NHB O-D TRIPS ADJUSTED
- - - HBW O-D TRIPS
- ..... EXTERNAL O-D TRIPS





# SCREENLINE "A"

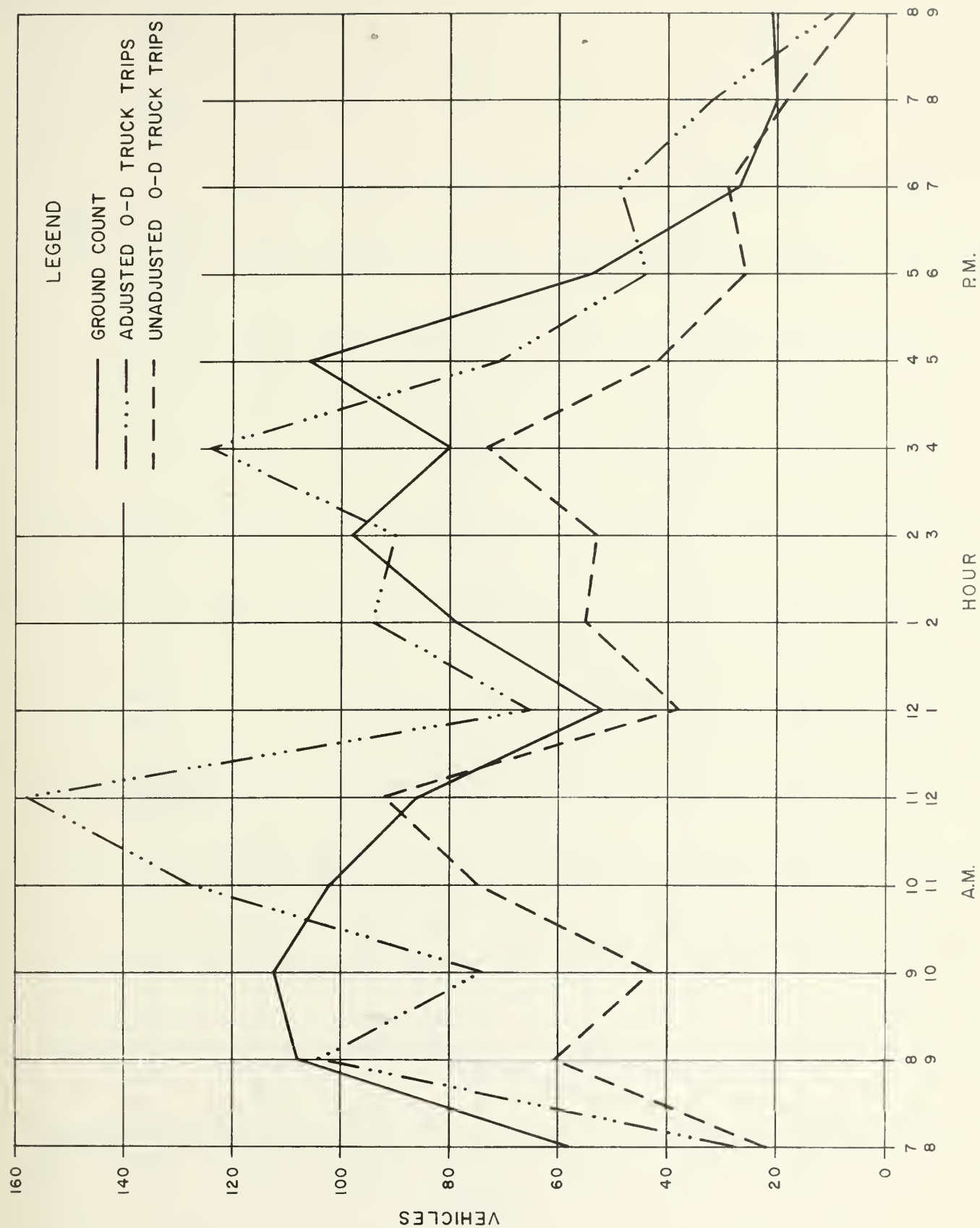


FIG. VI-4



# SCREENLINE COMPARISONS — TRUCKS

SCREENLINE "B"

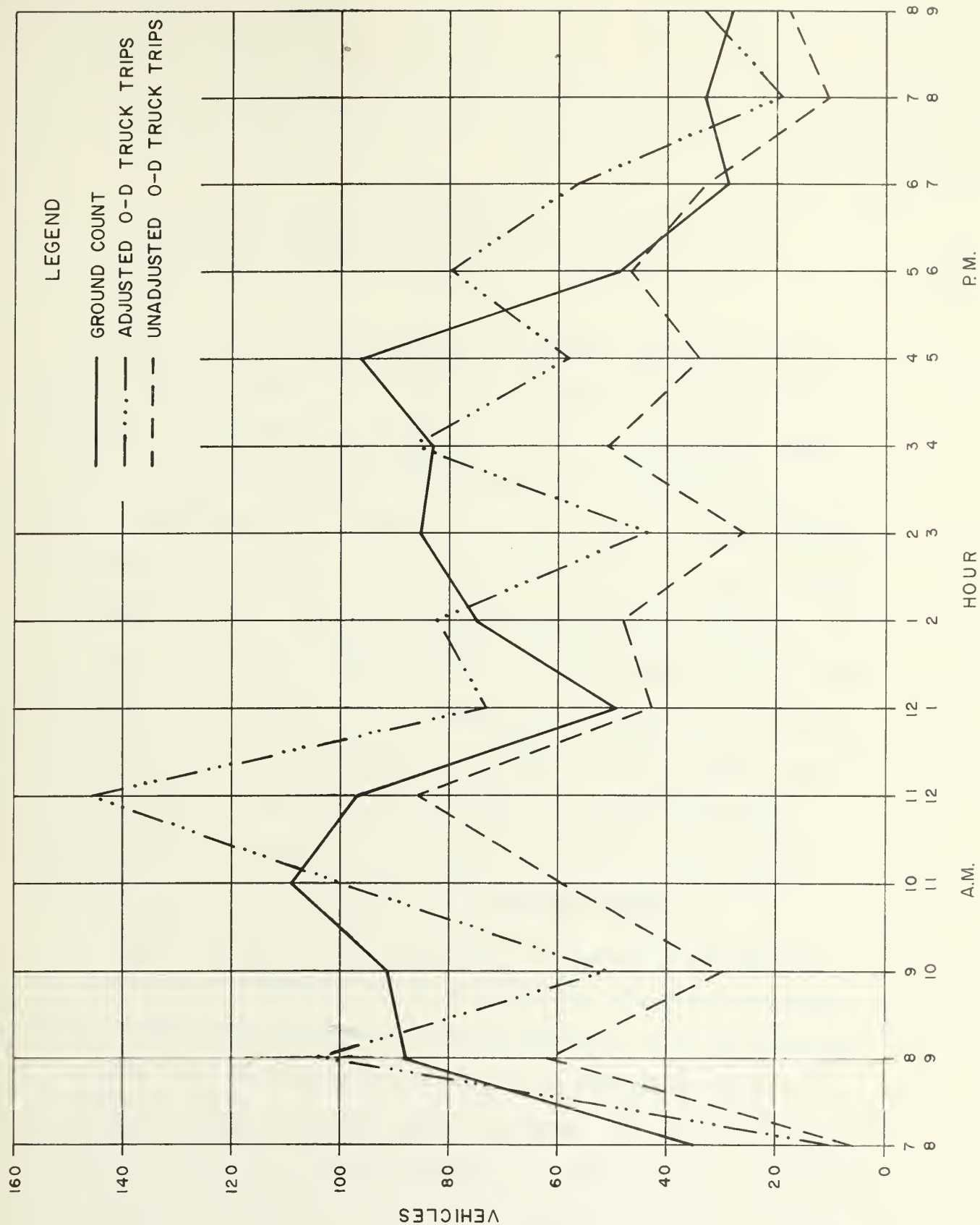


FIG. VI-5





## Chapter VII

### T R I P   G E N E R A T I O N   A N A L Y S I S

Trip generation analysis is important to the forecasting of future travel in the urban area. In this process current socio-economic data concerning the population of the area is related in mathematical terms to the current number and types of trips made. More specifically, equations are formulated which relate to the total number of trips originating or terminating in specific traffic zones to the data about people living or working in various zones. The assumption is made that these equations will remain valid over a period of time, generally twenty to thirty years. The introduction of future socio-economic data to these equations allows the calculation of future trip ends. In a later study procedure, these total trip ends are converted by traffic zone to more detailed trip tables, which may be assigned by computer to the major street network. This later study procedure is known as "trip distribution".

In order to select the most reasonable and statistically significant indicators of tripmaking and to establish the trip generation equations, a computerized procedure is normally followed. Both the selection of variables and the derivation of equations are operations performed by the stepwise multiple regression computer programs. Given a specified dependent variable ( a particular category of trip productions or attractions by zone) and an array of independent variables by zone (i.e. population, vehicles used, employment, etc.), the regression program will



produce one or more step equations together with statistics allowing the user to interpret the relative acceptability of the equation at each step, as shown below.

#### TYPES OF STEPWISE MULTIPLE REGRESSION EQUATIONS

First Step equation:

$$\text{Dependent variable} = (\text{coefficient}) (\text{independent variable}_1) \\ \pm \text{constant}$$

Second step equation:

$$\text{Dependent variable} = (\text{coefficient}) (\text{independent variable}) \\ \pm (\text{coefficient}) (\text{independent variable}_2) \\ \pm \text{Constant}$$

Third step equation:

$$\text{Dependent variable} = (\text{coefficient}) (\text{independent variable}_1) \\ \pm (\text{coefficient}) (\text{independent variable}_2) \\ \pm (\text{coefficient}) (\text{independent variable}_3) \\ \pm \text{constant}$$

At each step, another independent variable is added to the equation. Though the addition of such a variable may statistically improve the overall equation, the improvement may be very marginal. The program user should then revert to the preceding step equation. Fourth and higher step equations for the Helena Urban Transportation Study were developed for five major trip categories. These represented the most acceptable equations in respect to the associated statistical outputs. The equations for the Helena Transportation Study are included in Table VII-1.



TABLE VII-1

## H E L E N A   T R I P   G E N E R A T I O N   E Q U A T I O N S

HOME BASE WORK PRODUCTIONS by zone =  
 $0.80261 (\text{Employees/zone}) + 0.41363 (\text{Vehicles/zone}) - 0.11065 (\text{Dwelling units/zone})^*$

Multiple R = 0.6274, Sy.x = 1.204

HOME BASE WORK ATTRACTIONS by zone =  
 $1.16218 (\text{Employment/zone}) + 6.93106$

Multiple R = 0.9733, Sy.x = 44.4723

HOME BASE OTHER PRODUCTIONS by zone =  
 $0.96464 (\text{Persons over 5/zone}) + 1.23354 (\text{Vehicles/zone}) - 0.08676 (\text{Dwelling units/zone})^*$

Multiple R = 0.5037, Sy.x = 2.5132

HOME BASE OTHER ATTRACTIONS (Predominantly Residential) by zone =  
 $1.27271 (\text{Employment/zone}) + 0.57676 (\text{Enrollment/zone}) + 1.12693 (\text{Dwelling units/zone}) + 1.35470$

Multiple R = 0.8700, Sy.x = 82.8982

HOME BASE OTHER (Predominantly Residential) by zone =  
 Growth factored based on knowledge or the past trends of each zone and anticipated overall growth of the urban area.

NON-HOME BASE PRODUCTION & ATTRACTION (Predominantly Residential) by zone =  
 $1.51524 (\text{Dwelling/zone}) + 1.08400 (\text{Employment/zone}) + 0.20192 (\text{Enrollment/zone}) - 11.80228$

Multiple R = 0.9021, Sy.x = 54.7675

NON-HOME BASE PRODUCTION & ATTRACTION (Commercial) by zone =

$0.00052 (\text{Commercial Floor Space/zone}) + 1.84156 (\text{Employment/zone}) + 1.78628 (\text{Students/zone}) + 50.79719$

Multiple R = 0.8055, Sy.x = 168.2260

\* These were originally dwelling unit equations. To be used at the zonal level, the number of dwelling units per zone must be applied to the equation.



TABLE VII-1 (cont.)

INTERNAL TRUCK PRODUCTION & ATTRACTION by zone =  
 $1.12584 (\text{Truck/zone}) + 0.08381 (\text{Employment/zone}) + 0.0195 (\text{Dwelling Unit/zone}) + 2.29700$

Multiple R = 0.6699, Sy.x = 19.8079

EXTERNAL PREDOMINENTLY COMMERCIAL ZONES ARE GROWTH FACTORED  
 EXTERNAL ATTRACTION (Predominantly Residential) by zone =  
 $0.70767 (\text{Employment/zone}) + 0.24263 (\text{Vehicles/zone}) + 12.68359$

Multiple R = 0.8239, Sy.x = 43.2370

EXTERNAL PRODUCTION (Predominantly Residential) by EXTERNAL STATION =  
 Use growth factor based on knowledge of the past trends on each route.





Table VII-2

SPECIAL ANALYSIS ZONES

Zone #	
1	Telephone Company Building
12	Post Office Building
44	Vacant Land
47	Carroll College
48	National Guard Building and Park Land
49	Civic Center
66	Hospital
69	Capitol Buildings
85	Industrial Area
89	Sparsely populated semi-commercial zone
93	Airport
94	New Highway Department Complex & Commercial Area
95	Vacant Land
98	Commercial Area
108	Fairgrounds



The traffic analysis zones were reviewed to find those zones that should be considered "special generators". Special generator zones were composed of either vacant land or land containing unique characteristics (i.e. airport, Post Office, Capitol complex, etc.). These were eliminated from the regression analysis and future trip ends were developed by special procedures for all five trip purposes. (see Table VII-2).

The remaining zones were analyzed for the five trip purpose production and attraction equations. After the initial runs, it was found for some trip purposes, the data needed further stratification to make it more homogeneous. Not finding acceptable equations using all the zones, the zones were classified as "predominantly commercial" or "predominantly residential". Regression analysis was then rerun on the new groupings. (see Table VII-1). With this stratification, satisfactory results based on application of the resulting equations to the base year data for sixteen superzones were achieved. These computed totals for each superzone were listed alongside the actual O-D trips for the same areas. The percent difference between the estimated and the actual totals was then computed. The percent difference was compared to the "maximum allowable difference", as derived from Table IV-41 of the FHWA "Urban Transportation Planning Manual - General Information and Introduction to System 360". The maximum allowable difference was directly related to the numerical size of the control (O-D trips) totals; the largest groups had the smallest allowable errors.

### Conclusion

Thus, the equations for estimating future trip production and attraction in the Helena Urban Transportation Study were developed in respect to current and projected socio-economic characteristics of the



specific zones. These equations will be re-evaluated in updates to assure their constant applicability to the study area.



A P P E N D I X

A





## GLOSSARY OF TERMS

### ORIGIN AND DESTINATION SURVEY

A survey of travel by motor vehicles, designed to collect detailed information pertaining to the daily movement of vehicles, and persons, into, within and through an area.

### INTERNAL PHASE (Home Interview)

That phase of the survey in which travel and other information is collected by interviewing occupants of sample housing units within the study area.

### EXTERNAL PHASE (Roadside Interview)

That phase of the survey in which travel information is collected by interviewing vehicle drivers at roadside stations on the study area boundary.

### CORDON LINE

A hypothetical line delimiting the study area.

### CORDON INTERVIEW STATION

A station set up on a road crossing the cordon line at which traffic counts and roadside interviews are conducted.

### SCREENLINE

A line within the study area across which ground counts of vehicular traffic are made. These counts are used to check the accuracy of trip volumes derived from the interviews.

### ZONE

A geographical subdivision of the study area to which survey data is related for the purpose of traffic analysis and reporting.

### MOTOR VEHICLE

An auto, pickup, or truck.



## TRIP

One-way travel of a vehicle from a stated starting point (origin) to a stated first stop for a specific purpose (destination). Stops made to avoid conflict with traffic or to comply with traffic control signs and signals are not considered trips.

## TRIP TYPES

3 types of trips are defined by their purpose:  
home to work (home based work trips)  
home to other (home based other trips)  
other to other (non-home based trips)

## ORIGIN

Beginning point of a single trip.

## DESTINATION

Ending point of a single trip.

## INTRAZONAL TRIP

A one-way trip with origin and destination in the same zone.

## INTERZONAL TRIP

A one-way trip with an origin in one Zone and destination in another Zone.

## WEEKDAY

A typical or average day of a five-day week (Mon-Fri).

## PEAK TRAFFIC PERIOD

Those portions of the day during which a section of a roadway experiences its highest vehicle volumes. Generally, weekday peak traffic periods result from morning and late afternoon work trips. Sometimes expressed as Peak Hour.

## OFF PEAK TRAFFIC PERIOD

The remainder of the day not included in the peak period



## AVERAGE DAILY TRAFFIC (ADT)

The total volume of vehicles moving past a given point on a street, road or highway in a 24 hour period, averaged for 365 days of a specified year.

## TRAVEL DAY

A pre-designated day of the week for which complete records of all auto driver trips are obtained from all members of a sampled household.

## LAND USE

The purpose for which land and the structures thereon are used, classified into major groups, such as residential, commercial, industrial or agricultural.

## HOUSING UNIT

A house, apartment, or other group of rooms, or a single room when occupied or intended for occupancy as separate living quarters; such quarters having either a separate entrance and/or separate cooking facilities.

## HOUSEHOLD

The entire group of persons who live in one housing unit. It may include several persons living together or one person living alone. It includes the head of household and all other persons living there.

## GROUP QUARTERS

Group quarters included such places as hotels, motels, dormitories, and boarding houses. In the case of dormitories, each person, or occupied bed is counted as a group quarter unit; in cases of hotels, motels, etc., the occupied room is counted as the group quarter unit.

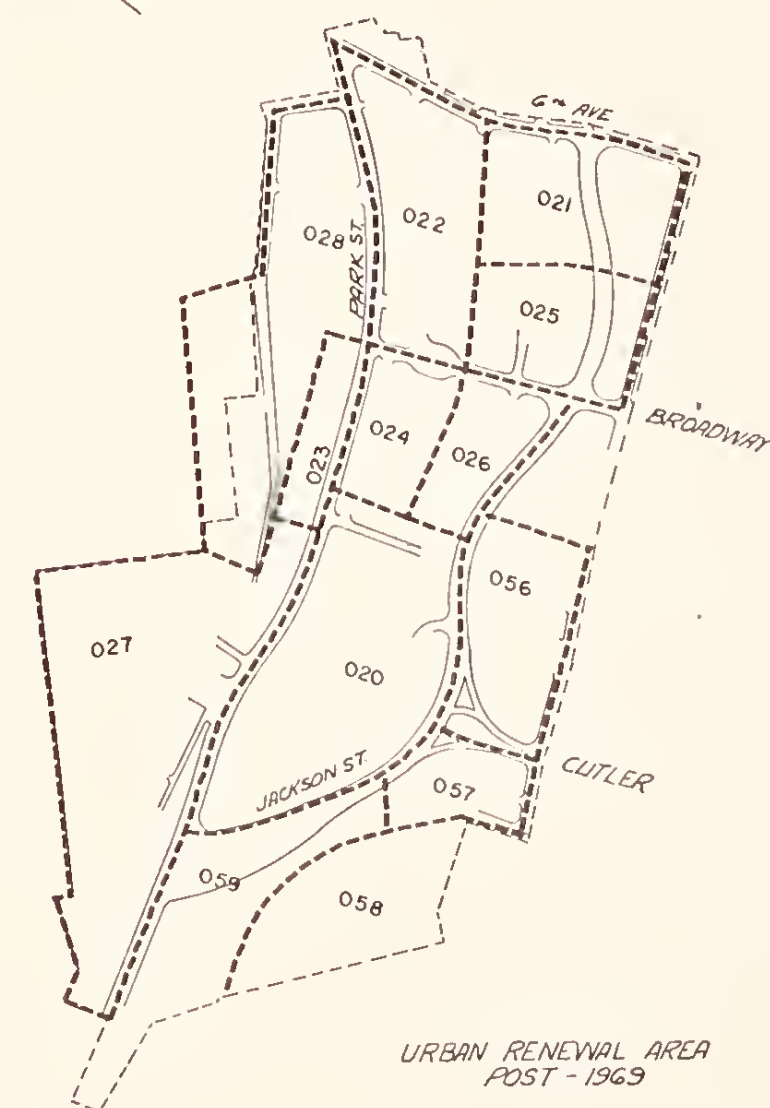
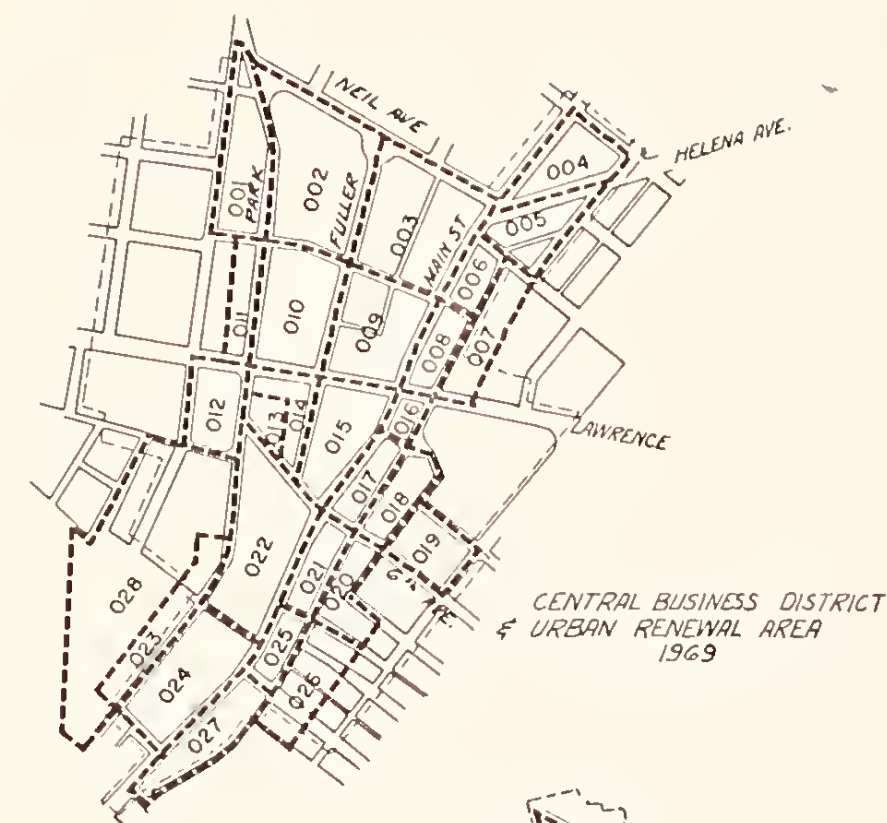
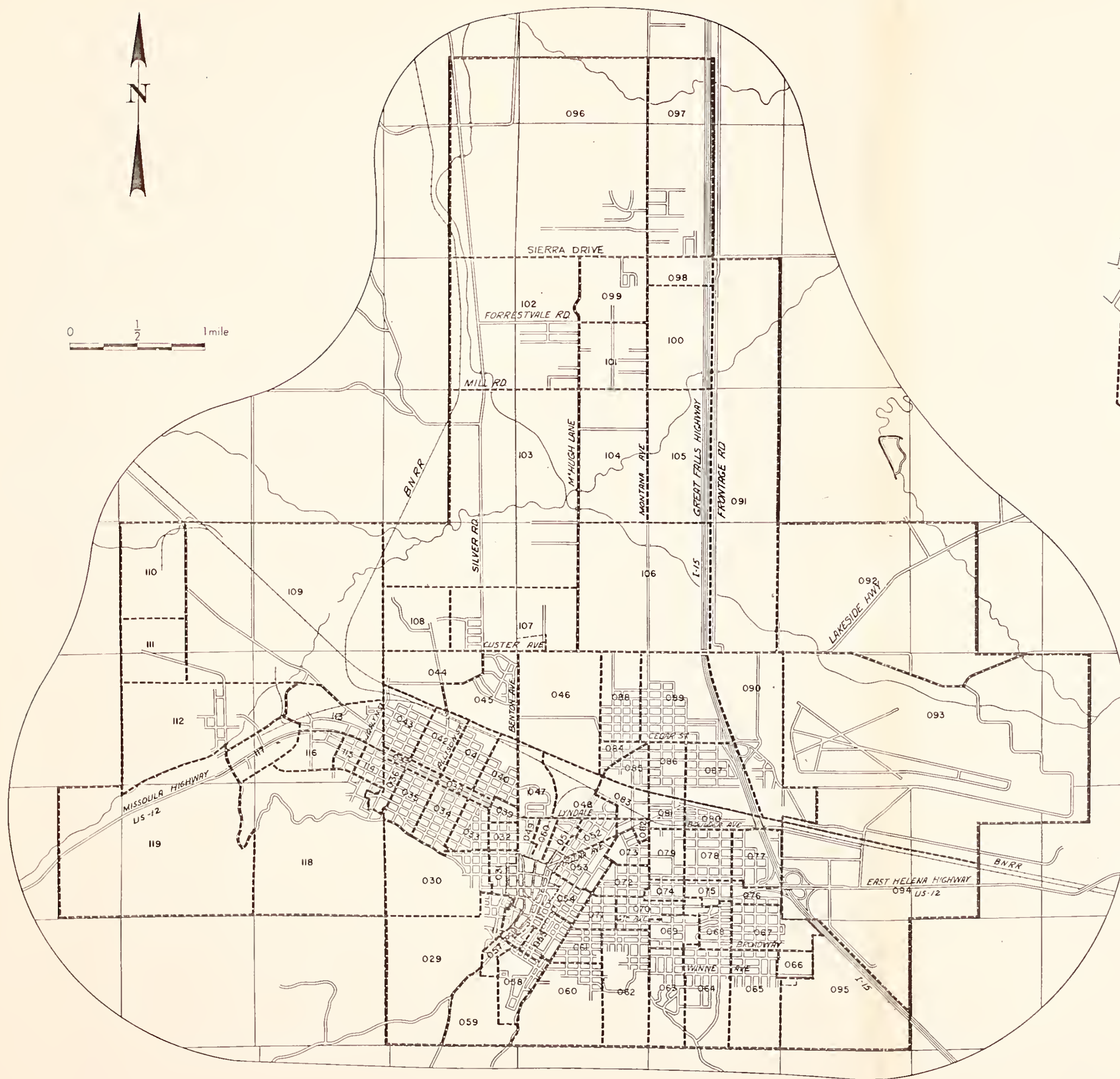


A P P E N D I X

B







1970 HELENA URBAN  
TRANSPORTATION STUDY  
TRAFFIC ANALYSIS ZONES



A P P E N D I X

C



HELENA URBAN TRANSPORTATION STUDY BASIC DATA SUMMARIZATION BY ZONE

ZONE NO.	3	5A SINGLE FAMILY UNIT	5B TWO FAMILY UNIT	5C THREE & OVER FAMILY UNIT	5D MOBILE HOMES	5E DORMS HOTELS & MOTELS	TOTAL PERSONS	TOTAL EMPLOYED	TOTAL STUDENTS	TOTAL CARS & PICKUPS
001	15	10	-	5	-	-	51	26	26	20
002	40	-	-	-	-	40	40	30	5	5
005	15	15	-	-	-	-	46	5	15	15
006	20	5	-	-	-	15	20	15	-	15
007	5	5	-	-	-	-	20	5	10	10
008	20	5	-	-	-	15	20	5	-	5
009	15	-	-	10	-	5	15	10	-	5
010	10	-	-	5	-	5	25	15	-	10
011	36	-	-	36	-	-	36	20	-	20
015	5	-	-	-	-	5	5	5	-	5
018	5	-	-	5	-	-	10	10	-	10
019	25	-	-	25	-	-	44	29	-	29
020	44	-	-	44	-	-	39	15	-	15
022	34	-	-	34	-	-	39	25	10	34
023	34	10	-	24	-	-	44	29	-	29
024	20	-	-	10	-	10	44	25	10	34





HELENA URBAN TRANSPORTATION STUDY BASIC DATA SUMMARIZATION BY ZONE

ZONE NO.	3	5A	5B	5C	5D	5E	6	10	12	16
	TOTAL D.U.	SINGLE FAMILY UNIT	TWO FAMILY UNIT	THREE & OVER FAMILY UNIT	MOBILE HOMES	DORMS HOTELS & MOTELS	TOTAL PERSONS	TOTAL EMPLOYED	TOTAL STUDENTS	TOTAL CARS & PICKUPS
025	25	-	5	-	-	20	29	29	-	10
026	43	5	-	54	-	-	83	44	10	39
027	25	25	-	-	-	-	74	15	29	25
028	113	49	20	39	-	5	211	123	29	132
029	98	68	15	10	-	5	255	127	44	152
030	137	98	19	15	-	5	358	147	88	216
031	315	130	35	150	-	-	690	275	160	315
032	120	67	19	34	-	-	331	115	139	221
033	178	163	10	5	-	-	600	221	182	322
034	178	139	29	10	-	-	682	221	230	398
035	158	153	-	5	-	-	590	226	235	322
036	62	57	5	-	-	-	264	115	110	144
037	38	24	-	-	14	-	72	48	5	67
038	5	5	-	-	-	-	14	14	-	14
039	38	28	5	5	-	-	125	38	29	72
040	216	187	10	19	-	-	806	317	341	350





## HELENA URBAN TRANSPORTATION STUDY BASIC DATA SUMMARIZATION BY ZONE

ZONE NO.	3	5A	5B	5C	5D	5E	6	10	12	16
	TOTAL D.U.	SINGLE FAMILY UNIT	TWO FAMILY UNIT	THREE & OVER FAMILY UNIT	MOBILE HOMES	DORMS HOTELS & MOTELS	TOTAL PERSONS	TOTAL EMPLOYED	TOTAL STUDENTS	TOTAL CARS & PICKUPS
041	206	192	14	-	-	-	706	322	206	408
042	110	105	-	-	5	-	451	187	130	230
043	72	72	-	-	-	-	274	101	101	134
045	82	82	-	-	-	-	312	125	101	158
046	5	5	-	-	-	-	15	5	-	10
047	725	40	10	-	-	675	880	90	710	220
048	14	9	5	-	-	-	29	10	5	19
049	85	60	5	20	-	-	220	100	60	140
051	5	5	-	-	-	-	5	5	-	5
052	215	150	25	40	-	-	565	260	195	325
053	365	190	65	105	-	5	850	375	190	435
054	230	110	35	85	-	-	650	170	210	240
055	343	127	29	167	-	20	691	255	137	314
056	73	38	5	29	-	-	176	69	54	83
057	54	34	10	10	-	-	98	49	15	39
058	156	117	15	24	-	-	456	167	172	191



HELENA URBAN TRANSPORTATION STUDY BASIC DATA SUMMARIZATION BY ZONE

ZONE NO.	3	5A SINGLE FAMILY UNIT	5B TWO FAMILY UNIT	5C THREE & OVER FAMILY UNIT	5D MOBILE HOMES	5E DORMS HOTELS & MOTELS	6 TOTAL PERSONS	10 TOTAL EMPLOYED	12 TOTAL STUDENTS	16 TOTAL CARS & PICKUPS
	TOTAL D.U.									
059	29	29	-	-	-	-	103	34	54	54
060	120	100	10	10	-	-	435	140	205	165
061	290	185	45	60	-	-	785	295	255	365
062	270	190	35	45	-	-	920	375	320	435
063	125	120	-	5	-	-	480	170	205	225
064	130	130	-	-	-	-	465	190	185	300
065	215	165	-	50	-	-	830	305	330	390
067	245	215	15	15	-	-	850	345	295	510
068	160	140	10	-	-	10	455	205	140	250
069	25	10	-	15	-	-	60	30	15	45
070	320	220	75	25	-	-	900	350	235	580
071	300	160	60	80	-	-	820	365	210	430
072	264	161	20	59	24	-	711	328	172	402
073	113	83	20	10	-	-	319	137	74	201
074	20	15	-	5	-	-	55	20	5	35
075	15	5	-	-	-	10	20	10	-	5



HELENA URBAN TRANSPORTATION STUDY BASIC DATA SUMMARIZATION BY ZONE

ZONE NO.	3	5A SINGLE FAMILY UNIT	5B TWO FAMILY UNIT	5C THREE & OVER FAMILY UNIT	5D MOBILE HOMES	5E DORMS HOTELS & MOTELS	6 TOTAL PERSONS	10 TOTAL EMPLOYED	12 TOTAL STUDENTS	16 TOTAL CARS & PICKUPS
TOTAL D.U.										
076	10	5	5	-	-	-	20	5	-	15
077	87	19	5	5	-	58	144	34	62	72
078	106	86	10	10	-	-	326	139	125	206
079	188	29	48	111	-	-	490	130	149	163
080	154	144	5	-	-	5	442	154	120	202
081	92	68	14	10	-	-	206	91	48	149
082	34	24	10	-	-	-	88	44	15	64
083	10	5	5	-	-	-	14	5	-	5
084	51	46	5	-	-	-	194	61	66	122
085	61	15	5	-	41	-	179	77	56	97
086	107	82	15	5	5	-	352	102	117	138
087	127	102	10	5	10	-	428	143	138	214
088	117	112	5	-	-	-	439	153	163	224
089	61	56	-	-	5	-	204	87	71	128
090	15	15	-	-	-	-	56	20	20	20
091	15	15	-	-	-	-	61	30	27	34



HELENA URBAN TRANSPORTATION STUDY BASIC DATA SUMMARIZATION BY ZONE

ZONE NO.	3	5A	5B	5C	5D	5E	6	10	12	16
	TOTAL D.U.	SINGLE FAMILY UNIT	TWO FAMILY UNIT	THREE & OVER FAMILY UNIT	MOBILE HOMES	DORMS HOTELS & MOTELS	TOTAL PERSONS	TOTAL EMPLOYED	TOTAL STUDENTS	TOTAL CARS & PICKUPS
092	34	24	-	-	10	-	132	59	25	74
094	35	15	5	-	5	10	110	35	60	65
096	70	70	-	-	-	-	280	95	115	155
097	110	110	-	-	-	-	395	140	146	270
099	83	41	-	-	42	-	291	135	73	177
100	59	30	-	-	29	-	206	98	64	127
101	73	73	-	-	-	-	267	103	95	168
102	44	20	-	-	24	-	154	57	66	97
103	19	19	-	-	-	-	64	16	19	35
104	78	69	4	-	5	-	292	108	125	181
105	45	45	-	-	-	-	150	61	54	102
106	20	20	-	-	-	-	50	30	10	45
107	48	39	-	-	9	-	167	84	48	97
109	27	24	-	-	-	3	112	34	34	54
110	5	5	-	-	-	-	25	5	5	10
111	23	5	9	-	-	9	69	14	28	14





HELENA URBAN TRANSPORTATION STUDY BASIC DATA SUMMARIZATION BY ZONE

ZONE NO.	3	5A SINGLE FAMILY UNIT	5B TWO FAMILY UNIT	5C THREE & OVER FAMILY UNIT	5D MOBILE HOMES	5E DORMS HOTELS & MOTELS	6 TOTAL PERSONS	10 TOTAL EMPLOYED	12 TOTAL STUDENTS	16 TOTAL CARS & PICKUPS
TOTAL D.U.	52	37	35	30	39	29	29	37	37	95
112	52	52	-	-	-	-	161	62	52	109
113	103	37	-	-	66	-	266	113	23	158
114	46	35	-	4	-	7	200	49	77	91
115	40	30	-	-	10	-	145	25	95	85
116	49	39	10	-	-	-	127	59	25	83
117	34	29	5	-	-	-	98	39	34	49
118	29	29	-	-	-	-	82	38	14	67
119	37	37	-	-	-	-	117	42	37	95
GRAND TOTAL	9887	6232	855	1554	304	942	27886	10670	9204	14665



A P P E N D I X

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OWELLING	UNIT	SUMMARY
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9
10	10	10
11	11	11
12	12	12
13	13	13
14	14	14
15	15	15
16	16	16
17	17	17
18	18	18
19	19	19
20	20	20
21	21	21
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26	26	26
27	27	27
28	28	28
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42	42	42
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88	88	88
89	89	89
90	90	90
91	91	91
92	92	92
93	93	93
94	94	94
95	95	95
96	96	96
97	97	97
98	98	98
99	99	99
100	100	100

[illegible]



## INTERNAL TRIP REPORT

CARD NUMBER		SAMPLE NUMBER				ZONE NUMBER				MONTH AND DAY OF TRAVEL				BLOCKS WALKED					
2		1 2 3 4 5				6 7 8 9 10 11 12				13 14 15 16 17 18 19 20				21 22 23 24 25 26 27 28 29 30 31					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
OCUP. and INDUS.	PERSON NUMBER	TRIP NUMBER	SEX	ORIGIN WHERE DID THIS TRIP BEGIN?	DESTINATION WHERE DID THIS TRIP END?	TYPE OF VEHICLE	TIME AT START	PURPOSE OF TRIP	NUMBER IN AUTO	TYPE OF PARKING AT DESTINATION	BLOCKS WALKED								
1 M	1	1	M	Address	Address	1 Auto	7:00	WORK	1	STREET FREE	1								
2 F	2	2	F	Land Use	Land Use	2 Non-Comm. Trucks	7:15	PERSONAL BUSINESS	2	STREET METERED	2								
1 M	3	3	M	Address	Address	1 Auto	7:30	MEDICAL-DENTAL	3	LOT FREE	3								
2 F	4	4	F	Land Use	Land Use	2 Non-Comm. Trucks	7:45	SCHOOL	4	LOT PAID	4								
1 M	5	5	M	Address	Address	1 Auto	8:00	SOCIAL-RECREATION	5	GARAGE FREE	5								
2 F	6	6	F	Land Use	Land Use	2 Non-Comm. Trucks	8:15	CHANGE TRAVEL MODE	6	GARAGE PAID	6								
1 M	7	7	M	Address	Address	1 Auto	8:30	EAT MEAL	7	SERVICE-REPAIRS	7								
2 F	8	8	F	Land Use	Land Use	2 Non-Comm. Trucks	8:45	SHOPPING	8	RES. PROPERTY	8								
1 M	9	9	M	Address	Address	1 Auto	9:00	SERVE PASSENGER	9	CRUISED	9								
2 F	10	10	F	Land Use	Land Use	2 Non-Comm. Trucks	9:15	HOME	0	NOT PARKED	0								
1 M	11	11	M	Address	Address	1 Auto	9:30	WORK	1	STREET FREE	1								
2 F	12	12	F	Land Use	Land Use	2 Non-Comm. Trucks	9:45	PERSONAL BUSINESS	2	STREET METERED	2								
1 M	13	13	M	Address	Address	1 Auto	10:00	MEDICAL-DENTAL	3	LOT FREE	3								
2 F	14	14	F	Land Use	Land Use	2 Non-Comm. Trucks	10:15	SCHOOL	4	LOT PAID	4								
1 M	15	15	M	Address	Address	1 Auto	10:30	SOCIAL-RECREATION	5	GARAGE FREE	5								
2 F	16	16	F	Land Use	Land Use	2 Non-Comm. Trucks	10:45	CHANGE TRAVEL MODE	6	GARAGE PAID	6								
1 M	17	17	M	Address	Address	1 Auto	11:00	EAT MEAL	7	SERVICE-REPAIRS	7								
2 F	18	18	F	Land Use	Land Use	2 Non-Comm. Trucks	11:15	SHOPPING	8	RES. PROPERTY	8								
1 M	19	19	M	Address	Address	1 Auto	11:30	SERVE PASSENGER	9	CRUISED	9								
2 F	20	20	F	Land Use	Land Use	2 Non-Comm. Trucks	11:45	HOME	0	NOT PARKED	0								
1 M	21	21	M	Address	Address	1 Auto	12:00	WORK	1	STREET FREE	1								
2 F	22	22	F	Land Use	Land Use	2 Non-Comm. Trucks	12:15	PERSONAL BUSINESS	2	STREET METERED	2								
1 M	23	23	M	Address	Address	1 Auto	12:30	MEDICAL-DENTAL	3	LOT FREE	3								
2 F	24	24	F	Land Use	Land Use	2 Non-Comm. Trucks	12:45	SCHOOL	4	LOT PAID	4								
1 M	25	25	M	Address	Address	1 Auto	1:00	SOCIAL-RECREATION	5	GARAGE FREE	5								
2 F	26	26	F	Land Use	Land Use	2 Non-Comm. Trucks	1:15	CHANGE TRAVEL MODE	6	GARAGE PAID	6								
1 M	27	27	M	Address	Address	1 Auto	1:30	EAT MEAL	7	SERVICE-REPAIRS	7								
2 F	28	28	F	Land Use	Land Use	2 Non-Comm. Trucks	1:45	SHOPPING	8	RES. PROPERTY	8								
1 M	29	29	M	Address	Address	1 Auto	2:00	SERVE PASSENGER	9	CRUISED	9								
2 F	30	30	F	Land Use	Land Use	2 Non-Comm. Trucks	2:15	HOME	0	NOT PARKED	0								
1 M	31	31	M	Address	Address	1 Auto	2:30	WORK	1	STREET FREE	1								
2 F	32	32	F	Land Use	Land Use	2 Non-Comm. Trucks	2:45	PERSONAL											





# DWELLING UNIT SUMMARY

URBAN AREA				TRANSPORTATION STUDY												INTERVIEW ADDRESS												CARD NUMBER																							
DATE				CALLS				DATE				MADE				DATE				INITIALS				LISTED OCCUPANT				PHONE				CITY CODE																			
DATE				HOUR				DATE				HOUR				DATE				HOUR				INITIALS				PRESENT OCCUPANT				PHONE				INTERVIEW NUMBER															
DATE				HOUR				DATE				HOUR				DATE				HOUR				INITIALS				ASSIGNED TRAVEL DAY				WEEKDAY CODE																			
DATE				HOUR				DATE				HOUR				DATE				HOUR				INITIALS				LETTER RECEIVED				YES				NO				TRIP LOG USED				YES				NO			
DATE				HOUR				DATE				HOUR				DATE				HOUR				INITIALS				ADDRESSES OF ADJACENT NEW HOMES OCCUPIED IN PAST YEAR?				PHONE				TRACT NUMBER				ZONE NUMBER				CENSUS ENUM. DISTRICT							
TOTAL NUMBER OF RESIDENCES																7 Motel																8 Institution																			
TYPE OF RESIDENCE: 1 Single family unit																4 Five and over apt.																9 Trailer																			
2 Duplex unit																5 Rooming house or dorm.																0 Mixed																			
3 Three or fourplex unit																6 Hotel																																			
NUMBER CARS OWNED & REGULARLY OPERATED																																																			
NUMBER PICKUPS & PANELS 0 & RO																																																			
NUMBER MOTORCYCLES USED REGULARLY																																																			
NUMBER OF PERSONS RESIDING AT THIS ADDRESS																NUMBER FIVE & OLDER																																			
CODING				PERSON IDENTIFICATION (ONLY THOSE OVER 5)				AGE				DRIVE				OCCUPATION				INDUSTRY				TRIPS ON TRAVEL DAY																											
DVP				STAGE				OCC				NO				YES				NO				YES				NO																							
1				2				3				4				5				6				7				8				9				10															
ANY VISITORS FROM OUT-OF TOWN WHO MADE TRIPS IN TOWN ON TRAVEL DAY																YES																NO																			
NUMBER OF OCCUPANTS MAKING REGULAR TRIPS ON CITY TRANSIT BUSES																																																			
NUMBER OF CAR TRIPS REPORTED AT THIS ADDRESS																																																			
NUMBER PICKUP & PANEL TRIPS REPORTED AT THIS ADDRESS																																																			
NUMBER MOTORCYCLE WORK OR WORK RELATED TRIPS REPORTED																																																			
NUMBER TRIPS MADE ON CITY TRANSIT BUSES																																																			
NUMBER DRIVERS: WITH A-D TRIPS																WITHOUT A-D TRIPS																UNKNOWN A-D TRIPS																			
NUMBER EMPLOYED																NUMBER STUDENTS																																			
FINAL INTERVIEW STATUS																																																			
(Save this question to end of interview)																																																			
APPROXIMATE GROSS ANNUAL INCOME OF ALL FAMILY MEMBERS																\$																																			
MONTANA																HIGHWAY																COMMISSION																			



三、關於「三民主義」

[illegible]

1. Lewis & Clark  
County Vehicles
2. Montana Vehicles,  
not L. & C. County
3. Out of State

1. Passenger Car Local
2. Passenger Car Foreign
3. Pick-up or Panel
4. 2-Axle, Single Tire
5. 2-Axle, Dual Tire
6. 3-Axle, Single Unit
7. Combinations
8. Taxi
9. Bus

1. Work
2. Business
3. Med - Dental
4. School
5. Social & Re
6. Change mod
7. Eat Meal
8. Shopping
9. Serve Passe
0. Home (or O

Same as  
Column 7



Page \_\_\_\_\_ of \_\_\_\_\_  
Interviewer \_\_\_\_\_  
Date \_\_\_\_\_

Card No. \_\_\_\_\_ 4  
City Code \_\_\_\_\_ 2  
Sample No. \_\_\_\_\_ 3 4 5 6  
G.V.W. \_\_\_\_\_ 7 8  
Zone No. \_\_\_\_\_ 9 10 11

DRIVER \_\_\_\_\_ ADDRESS \_\_\_\_\_ PHONE \_\_\_\_\_  
TRAVEL DATE \_\_\_\_\_ Month/Day of Week \_\_\_\_\_  
NUMBER OF TRIPS ON TRAVEL DATE \_\_\_\_\_

4 - pickup or panel	5 - other 2S single unit	6 - 2D single unit
7 - 3D single unit	8 - combinations	

[illegible]





**MONTANA HIGHWAY COMMISSION  
PLANNING SURVEY SECTION  
TAXI INTERVIEW SHEET**

Interviewer

Sheet \_\_\_\_\_ of \_\_\_\_\_

5

Card No.

Owner

License No.

Date of Travel:

Total Number of Stops or Trips

Estimated	Days	Mileage within Area
100	10	100
200	20	200
300	30	300
400	40	400
500	50	500
600	60	600
700	70	700
800	80	800
900	90	900
1000	100	1000

## Address

Cab No

**Make**

Day of week

Year of Mfg.

[illegible]







